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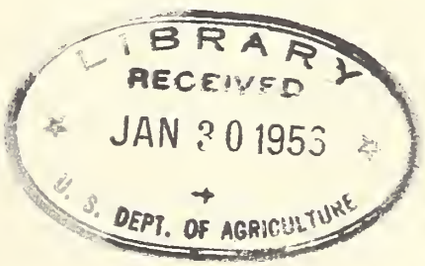

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In 1946 the Forest Insect Laboratory at Gulfport, Mississippi, began a large series of tests to determine the effectiveness of various chemicals as soil poisons in preventing subterranean termite damage to wood structures. These tests are being conducted largely at the Harrison Experimental Forest at Saucier, Miss., about 20 miles north of the Gulf of Mexico.

Some of the newer insecticides such as DDT, BHC, toxaphene, chlordane, and dieldrin are being studied in comparative tests with such generally used soil poisons as coal-tar creosote, orthodichlorobenzene, pentachlorophenol, and sodium arsenite. Certain of the chlorinated hydrocarbon chemicals have proved to be effective and economical. The study also includes a number of other chemicals which might have some value. Among these are copper naphthenate, monochloronaphthalene, lead arsenate, tetrachlorobenzene, trichlorobenzene, copper ammonium fluoride, copper sulfamate, and copper sulphate. Nearly all formulations were applied at several concentrations and dosages.

A comprehensive account of the tests will be published during 1955. This summary is being released in advance because information on soil poisons is in strong and urgent demand by various military agencies, the building industry, pest control operators, and home owners.

1/ This investigative study was made by the writer between 1946 and 1953 while an Entomologist at the Gulfport Forest Insect Laboratory. The study was made possible by a cooperative arrangement between the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, and the Corps of Engineers, Department of Defense. Acknowledgment is gratefully made to S. C. Dews, formerly Entomologist at this laboratory, and H. R. Johnston, Entomologist, for their contributions and participation in establishing the 1946 tests; to R. J. Kowal, Entomologist, for technical suggestions and to those participating in the 1954 annual field examinations.

Summary

Three methods of testing were employed. Stake tests, simulating in certain respects the trench treatment of buildings, were studied most intensively. This method involves removal of 2 cubic feet of soil from a hole 15 inches in diameter and 19 inches deep. The soil is treated with the desired dosage of chemical and replaced in the hole, after which a 2 x 4 x 18-inch pine sapwood stake is driven to a depth of 12 inches in the center of the backfilled, treated soil. Thus, before any termites can attack the stake, they must cross or penetrate the treated soil.

Groundboard tests are useful to determine concentrations and dosages for application to the soil surface to protect wood stored on the ground or for poisoning beneath concrete slabs in buildings. In this method, all vegetation is removed from a 17-inch square of soil and a measured amount of insecticide is sprinkled evenly over the soil surface. Then a 1 x 6 x 6-inch pine board is laid flat on the top of the treated soil.

In building tests, the chemicals were applied in shallow trenches along the foundation chainwalls. The trenches were about 4 inches wide and 6 inches deep; half of the chemical dosage was poured into the bottom of the trench and the remainder was mixed into the backfilled soil.

The outstanding results of the various tests were as follows:

Stake Tests

1. Benzene hexachloride (5.36 pounds of gamma isomer in 100 gallons of insecticide-kerosene formulation). Applied at a dosage of 1-1/4 gallons to 5 cubic feet of soil, this material has given complete protection against termite attack for at least 8 years. In addition to being very effective, this BHC formulation was an economical soil poison. Half this concentration gave complete protection for 4 years and 90 percent protection for 5 years. These solutions are approximately 0.8 and 0.4 percent gamma concentrations on a weight/weight basis when prepared from technical grade 36 percent gamma BHC. Lower concentrations and dosages were less effective.

2. DDT (63.5 pounds in 100 gallons of insecticide-fuel oil formulation). Applied at a dosage of 1-1/4 gallons to 5 cubic feet of soil, this formulation gave complete control for 5 years and 90 percent control for 6 years. No further damage showed up during the

seventh, eighth, and ninth years. On a weight/weight basis, this is approximately an 8 to 9 percent DDT concentration, depending upon the specific gravity of the fuel oil and auxiliary solvents used. A higher concentration (75 pounds in 100 gallons of insecticide-fuel oil formulation) and dosage has given complete protection for the 6-year duration of the test. A 5 percent DDT emulsion in water (66.7 pounds in 100 gallons of treating emulsion), applied at a dosage of 2 gallons to 5 cubic feet of soil, was unsatisfactory and permitted light termite damage within 2 years after treatment. The performance of DDT in fuel oil solutions was superior to that in other carriers tested, among which were kerosene, gasoline, waste motor oil, water, and others.

3. Sodium arsenite (about 9 percent in water). Applied at a dosage of 2 gallons per 5 cubic feet of soil, this formulation has given complete protection in tests that have been under way for 6 years. In tests run in Beltsville, Md., and in the Canal Zone this chemical has been highly effective for at least 9 years.

4. Trichlorobenzene (1 part to 3 parts No. 2 fuel oil). Applied at a dosage of 2 gallons to 5 cubic feet of soil, this solution has given 90 to 100 percent protection in tests under way for 6 years. Slight failure occurred in the third and fourth years of tests with a water emulsion of the same concentration. This chemical is effective but expensive.

5. Orthodichlorobenzene (1 part to 3 parts No. 2 fuel oil). Applied at a dosage of 2 gallons to 5 cubic feet of soil, this formulation gave complete protection for 3 years and 80 percent protection for 5 years.

6. Pentachlorophenol (5 percent in kerosene). Applied at a dosage of 1-1/4 gallons per 5 cubic feet of soil, this solution gave complete protection for 2 years, 90 percent protection for 3 years, and 30 percent protection for 5 years. Five and 6 percent concentrations in No. 2 fuel oil, applied approximately at rates of 2 gallons per 5 cubic feet of soil, gave 70 to 100 percent protection for 3 years, and 40 to 60 percent protection for 5 years. A 5 percent concentration in No. 2 fuel oil, applied at the rate of 3.1 gallons per 5 cubic feet, gave 80 percent protection for 5 years.

7. Monochloronaphthalene (1 part to 9 parts and 1 part to 19 parts kerosene). Applied at 1-1/4 gallons to 5 cubic feet of soil, these solutions gave 90 to 100 percent protection for 2 years. Numerous failures developed within 3 years.

8. Coal-tar creosote (1 part to 1 part, and 1 part to 3 parts kerosene). Failures began developing within 1 and 2 years when these solutions were applied at dosages of 1-1/4 and 2 gallons per 5 cubic feet of soil, respectively.

9. Copper naphthenate (8% metallic copper concentrate diluted 1 part to 3 parts of kerosene). This formulation failed within 1 year when applied at a dosage of 1-1/4 gallons per 5 cubic feet of soil.

Groundboard Tests

Soil surface treatments were tested usually at dosages of 1/2 and 1-pint per square foot of soil surface.

1. Benzene hexachloride in No. 2 fuel oil and in water emulsion (at about 0.4 and 0.8 percent gamma concentrations), each at a 1-pint dosage, has given complete protection for 6-year duration of the test.

2. Chlordane in No. 2 fuel oil (at about 1 and 2 percent concentrations), at both 1/2 and 1 pint dosages, has given complete protection for 6 years. Chlordane 2-percent in water emulsion at a 1-pint dosage has given complete protection for the 6-year duration of the test. This emulsion is a very economical termite soil poison.

3. DDT (at about a 5 percent concentration) in diesel oil. Severe failure occurred within 4 years when the low dosage of 1/2 pint per square foot of soil was used. At the 1-pint dosage, the first failure occurred within 4 years, but at 7 years this treatment was still giving 80 percent protection. When DDT was used in kerosene, numerous failures occurred within 3 and 5 years, respectively, with the 1/2 and 1-pint dosages. In these tests DDT in diesel oil was a more effective termite soil poison than DDT in either waste motor oil or gasoline.

4. Dieldrin in water emulsion (at about 0.25, 0.5, and 1.0 percent concentrations). Applied at 1 pint per square foot of soil, each of these concentrations has given complete protection in tests that have been under way 5 years.

5. Toxaphene in No. 2 fuel oil (about an 8 percent concentration). It has given complete protection in tests run for 6 years. In water emulsions, failures began to show up within 2 to 3 years.

6. Sodium arsenite in water (at about a 10 percent strength). Failures began to show up within 3 years.

7. Pentachlorophenol (5 percent in heavy oil). This solution began to fail in the first and second years.

8. Coal-tar creosote (1 part to 3 parts kerosene, and 1 part to 1 part No. 2 fuel oil). Failures showed up in at least 50 percent of the tests within 2 years.

9. Copper ammonium fluoride (1 and 2 percent in water). These concentrations failed rapidly.

Building Tests

Results of tests after 6 years' service generally followed the trend shown by the field stake tests; as follows: Sodium arsenite gave complete protection under buildings--it was not tested outdoors; DDT in petroleum oil gave 97 to 100 percent protection under buildings, and 83 to 86 percent protection outdoors--the emulsions showed failure in both exposures; coal-tar creosote, NC compound, orthodichlorobenzene, and pentachlorophenol in petroleum oil all had comparatively high degrees of failure.

It should be remembered that tests conducted in Mississippi apply largely to the Gulf Coast area, and may not apply identically to other areas. However, the results of tests conducted in widely different areas indicate that the trends and relative effectiveness shown by certain treatments are similar in the various latitudes where subterranean termites are found. For example, while concentrations and dosages effective in Mississippi for 5 years give a much shorter period of protection in the tropics, they give a longer period of protection in the latitude of central United States. All treatments discussed in this paper displayed the same trends in effectiveness in the different areas.